REMARKS

Applicants thank Examiner Vinh for the careful examination of the application and clear explanation of the objection and rejections. In response, Applicants renumber the claims to overcome the objection and amend claim 12 to overcome the rejection without adding new matter.

As amended, claim 12 describes a of endpoint detection in plasma etching of a target layer of material, comprising the following steps:

1. Measuring the voltage across a plasma system by measuring the voltage across an element that is external to said plasma system;
2. Detecting a change of the voltage across the element prior to the completion of the etching of the target layer of material; and
3. Stopping etch when the voltage change exceeds a predetermined amount within a predetermined time.

The amendment is fully supported in the original description and the amended claim distinguishes from the cited reference.

a. The amendment is fully supported by the original description.

In the background section of the application, Applicants explained that a common method for determining endpoint is through spectral emissions of reactant gases in the plasma chamber. The intensity of spectra changes whenever the electrical and chemical conditions in the system change. Such changes occur when a desired layer is fully etched, exposing the underlying layer.[1]

The method described in claim 12, on the other hand, detects a DC voltage change across the plasma system caused by change in the thickness of the layer that is being etched. As an example, when the target oxide-layer being etched becomes thinner, the charge on the surface of the etched oxide attracts charge from the far side of the nitride to form a capacitance. As the oxide layer thins, this capacitance

[1] See p. 3, ¶ 1 of the application.

changes.[2] This change in capacitance changes the voltage across the external element and the method of claim 12 detects a signal - the change of the voltage across the element - prior to the completion of the etching of the target layer of material.

b. The claim as amended distinguishes from the cited reference.

The method taught in the Winniczek reference depends on the completion of etching of the target layer, the basic theory is stated in the background section:

> It has been found that, as the target layer etch is completed and the underlayer is exposed to the plasma, the self-induced bias of the substrate may change. By way of example, for the etch of a dielectric target layer, the self-induced bias of the substrate is observed to change as a conductive underlayer is exposed to the plasma. As a further example, for the etch of a conductive target layer, the self-induced bias of the substrate is observed to change when a dielectric underlayer is exposed to the plasma. By monitoring the change in the self-induced bias of the substrate, the end of etch process may be ascertained for endpointing purposes.[3]

The Winniczek reference teaches a method to overcome the difficulty of measuring this self-induced substrate bias when an electrostatic chuck is employed in the plasma processing system.[4] Unlike prior art techniques that measure the electric potential of the substrate directly, the Winniczek reference teaches detecting a change in the currents supplied to the poles of the electrostatic chuck[5]. Nevertheless, the detection depends on the completion of the etching of the target layer as evidenced in the following passages of the reference.

> It is discovered by the inventors that the compensation voltage changes as the etch progresses and typically changes dramatically as the target layer is cleared, i.e., etched through.[6]

> As the etch clears the target layer, a significant change in the compensation voltage is typically observed....Irrespective of the exact shape of the compensation voltage plot at the time the etch ends, the end of the etch is typically evidenced by a clearly discernible change in the compensation voltage.[7]

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[2] See p. 7, ¶ 1 of the application.
[3] US 6,228,278, col. 1, ll. 52-62.
[4] See, id., col. 3, ll. 62-67.
[5] See, id., col. 7, ll. 5-6.
[6] Id., col. 4, ll. 36-39.
[7] Id., col. 6, ll. 21- 30.

> In accordance with another embodiment of the present invention, it is also possible to monitor control signal itself for changes characteristic of the end of the etch for endpoint purposes. In accordance with yet another embodiment of the present invention, the currents through the legs themselves may be monitored (by, for example, monitoring the outputs of current monitor circuits) for changes in the current(s) that are indicative of the end of the etch process.[8]

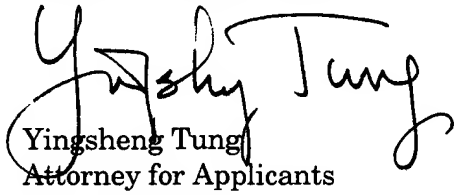
It is clear that the Winniczek reference teaches a method that detects the current from a power supply to an electrostatic chuck and looks for a discernible change of the current at the clearing of the target layer and the exposing of the underlayer. In contrast, claim 12 of the present invention detects a voltage change across an external element prior to the completion of the etching of the target layer of material.

In summary, the amendment in claim 12 is fully supported by the original description and as amended, claim 12 distinguishes from the cited reference. Claim 1, therefore, stands patentable over the cited reference.

Calms 13, 14, and 20 depend on claim 12 with additional limitations. In particular, claim 13 limits the external element to a resistor; claim 14 further limits the predetermined amount of voltage change to be not less than 5% form a reference voltage and the predetermined time to be not less than 3 seconds; and claim 20 the external element to be a part of an impedance matching network. Claims 13, 14, and 20 stand patentable.

Applicants respectfully submit that the application is in allowable form and claims 12, 13, 14, and 20 stand patentable over the cited reference for the reason set forth. Applicants respectfully request further examination and consideration of this application.

Respectfully submitted,



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[8] Id., col. 6, ll. 53-61.